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A METHOD ~~OF~~ For MANUFACTURING FEED PELLETS AND A PLANT FOR USE IN THE IMPLEMENTATION OF THE METHOD

This invention relates to a method of manufacturing feed pellets, whereby moist feed pellets are subjected to negative pressure followed by a drying process, in order to achieve a more porous pellet and a lower temperature load.

The invention also relates to a plant for use in the implementation of the method, the plant generally comprising a pellet chamber, preferably interconnected downstream of a pelletizing machine, an extruding device for pellets or a similar pellet forming device.

Feed pellets for fish and animals are manufactured on an industrial scale in a multistage process. The components are mixed to a dough-like body, which is formed into pellets by high pressure and high temperature, for example in a so-called extruder, after which the pellets are dried and cooled. As warm pellets, typically holding 100 to 140°C, are pressure relieved to ambient pressure, the pellets expand because of the internal pressure and liquid boiling out of

the pellets. The expansion results in the pellets having a porous structure.

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The pellets are cut into pieces of desired length. Considerable remaining moisture in the expanded pellet involves that the pellets have to be dried to obtain keeping quality. Such drying may be done in several ways, and some of them should be well known to a person skilled in the art.

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The porosity or specific gravity of the completely formed product may be an important criterion of quality of several types of food and feed products, including feed pellets for reared fish. The porosity of the product is of importance to the possibility of adding liquid nutrients which are absorbed into the product; the porosity is further of importance to floating capacities in a suitable medium, and it is of importance to the texture criterions like crispness, mouth sensation and toughness. To pellets of fish feed the porosity is important with respect to the ability of the pellets to absorb oil in the production process, and for the floating capacity/buoyancy in water on feeding.

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Existing methods of manufacturing are hard to control accurately, in order for the product to have the desired porosity or sufficient porosity for the products, feed substances, feed pellets etc. to achieve the desired absorption of fat.

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For some products it will be important to be able to control the production process towards a minimum of expansion in for example pellets, whereas the opposite will be the case for other products. In producing, among other things, feeds for pets such as for example dogs and cats, and feed for reared

fish, this possibility of controlling the degree of expansion/porosity is essential, because the aim is often to enable addition of as much fat/oil as possible in a subsequent processing stage. For fish feed the control of its degree of expansion is particularly important because such feed should, in addition, exhibit defined sinking capacities in water after its fat/oil absorption.

The most common method of increasing the porosity is to increase the mechanical and thermal amount of energy added to the raw materials in the extruding stage of the manufacturing process. When the initial mixture contains surplus vapour after extrusion, the surplus vapour will expand and result in greater porosity. It is also possible to supply compressed gas to the extruder, as disclosed in US patent document No. 5 587 193. In patent publications WO 9503711 and 9816121 are mentioned means for reducing porosity after the extruding stage by extracting positive pressure and surplus vapour inside the extruder. In US patent document No. 5 527 553 is explained a method, in which the pellets are passed directly into a warm oil bath at 107-232 °C and cut into a desired length in the oil bath. The degree of expansion of pellets is controlled by changing the oil temperature.

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An object of the invention is to provide a method and a plant of the initially mentioned kinds, for use in the manufacturing of porous pellets, whereby a better control of the porosity of the feed product than by known technique may be maintained.

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Another object is to achieve a lower temperature load on the product through the processing. Since known methods normally require an extra supply of energy, such as heat, to achieve

increased expansion, the opposite effect of what was normally to be expected has been achieved by means of the invention. By the use negative pressure also in the subsequent drying process and possibly a deep-frying process, an essentially lower temperature load can be achieved for the product than by conventional methods.

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In a method of the kind specified initially, this object is realized by proceeding in accordance with the characterizing part of the following claim 1, and by a plant of the initially specified kind for the implementation of the method, being formed so that it exhibits the features stated in the characterizing part of claim 9.

According to the invention the procedure is such that the pellet is produced, discharged by or extruded by a pressure which is lower than the ambient pressure, pellets being transferred, after a relatively short stay by said reduced pressure, to a drying process.

A plant for the implementation of this method comprises a pellet chamber which is interconnected in the plant, downstream of the pelletizing machine, and the plant excels by said pellet chamber being arranged to be able to be kept at a lower pressure than the ambient pressure, for example in the order of 100-800 millibar.

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In practice this is normally done by extruding pellets in a manner known in itself, but with the important difference of the extruder discharging the pellets into said pellet chamber which works by reduced pressure. The use of reduced pressure will in this connection provide improved cooling, i.e. a small temperature load on the feed, increased evaporation of

water binding heat. Pellets subjected to reduced pressure will also expand more than usual, and increased evaporation of water contributes to the attainment of a more porous pellet. The expansion may be adjusted by adjusting the negative pressure. So far, experiments carried out have shown that the pellets' stay by low pressure may be of a short duration, in typical cases from a few seconds up to one minute, after which the pellets are passed to a drying process.

Experiments have shown that the pellet temperature drops from about 90 to about 50°C when the pressure (inside the pellet chamber) is reduced from 1000 to 200 millibar. At the same time the pellet becomes more porous after the negative pressure treatment, as the density (less weight per unit of volume) decreases from about 450 to 280 grams per litre of pellets. Other experiments have shown that also pressure lower than 200 millibar has a favourable effect on the control of the porosity of the feed pellets.

The table below shows the results obtained in a series of experiments with extruded fish feed by the use of the method and plant according to the invention. The results show a marked increase in the pellet diameter and a reduction in the bulk density as a measurement of expansion when the pressure inside the pellet chamber is reduced from 1000 mbar to 200 mbar. The temperature of the product also decreases by dropping pressure, as a consequence of increased evaporation. The experiment referred to, is only illustrative and not limiting to the scope of the application.

Absolute pressure (mbar)	Pellet diameter (mm)	Bulk density (g/l)	Temperature of pellets (°C)	Evaporation of water (g/kg of feed)
1000	8.3	460	91.2	5
800	9	416	80.5	6
600	9.1	368	70.4	11
300	10	296	59.8	-
200	10.2	284	52	15

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In the experiments mentioned the period of stay by negative pressure in the pelletizing chamber was 20 seconds. Experiments with continuous discharging from the pellet chamber (i.e. a stay of less than 5 seconds), and a stay of 40 seconds have shown corresponding results for expansion, as those stated above.

A plant for use in the manufacturing of feed pellets excels, according to the invention, by the pellet chamber being arranged to allow itself to be kept at a lower pressure than the ambient pressure, its outlet being connected to an oil tank or a drying plant, to which the pellet is transferred, and wherein the oil tank or the drying plant is also arranged to be able to maintain a lower pressure than that of the surroundings.

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It has proved convenient to let the subsequent drying process also be implemented by a pressure which is lower than the

ambient pressure. This stage of the method is advantageous in that it favours the attainment of the object aimed at, but this stage is not critical in the implementation of the method to achieve a satisfactory result. The same applies to the deep-frying process which is implemented by reduced pressure in a tank filled with oil, whereby the deep-frying process constitutes said subsequent drying treatment. For the rest, the drying process may be carried through in a known manner, for example by drying in air.

Also, the invention comprises a method whereby the pelletizing is carried out by a first reduced pressure, whereas the subsequent drying is implemented at a second reduced pressure.

Said first pressure and said second pressure may be identical or different from each other.

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As mentioned, reduced temperature will be favourable to temperature sensitive components, and increased porosity is favourable to the capacity of the pellets to absorb oil, whether the oil is added in connection with the deep-frying, or the oil is added after the pellets have been dried in another way (for example by drying in warm air).

The outlet of the pellet chamber may have a rotatable gate lock body arranged thereto, enabling formed pellets to be drawn continuously or in batches, while, at the same time, the negative pressure is maintained.

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According to the invention pellets are produced in a pelletizing machine and passed from there into said pellet chamber which works at reduced pressure. The degree of

negative pressure relative to the atmospheric pressure is adjusted with a view to the desired expansion of pellets. This has turned out to provide an essentially better control of the expansion and porosity, than measures which have to be taken in a known manner before or during pelletizing. The reason is believed to be that in changing single parameters of the pelletizing process, other parameters are also influenced, which are very important for a good result. This is because the pelletizing process creates physical and chemical structures of the raw materials by means of the same measures that control expansion (heat, water and pressure).

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One should perhaps believe that the same effect as by the invention could be achieved by increasing the pressure by pelletizing and producing pellets into free air with the same pressure drop as the one achieved by the invention. However, such a pressure increase does not have that effect. There will normally be operated with pressure variations, in for example the extruding process, way over 1 atmosphere (about 1000 millibar), without this affecting expansion and porosity in a manner worth mentioning. In the production of animal feeds the pressure before pelletizing will be between 15 and 40 atmospheres, depending on the choice of raw materials and desired quality of the final product. Pressure is one, but not the most essential process parameter for adjusting the expansion.

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As an explanation of the surprising effect obtained by the application of the invention, a more rapid boiling out of water and subsequent temperature drop are considered to be the most important ones. The drop in temperature results in the pellet matrix setting, thereby preventing the shrinking effect which is otherwise to be expected.

The pressure within the pellet chamber may be in the pressure range from 0 millibar to right below atmospheric pressure, and will in typical cases be between 100 and 800 millibar.

According to the method of the invention, porous pellets are produced in a manner known in itself, but with the novel feature of pellets being discharged into a pellet chamber which is kept at a pressure lower than the ambient pressure, typically in the range from one hundred to eight hundred millibar.

According to the method of the invention, water is removed from the pellets, and the pores are filled with fat in subsequent processing stages.

According to the invention the outlet of known pelletizing equipment has a pellet chamber arranged thereto, which is arranged to be able to be kept at a lower pressure than the surroundings, and which is provided with a gate lock opening so that pellets may be drawn continuously or in batches from the pellet chamber, while the chamber is kept by a reduced pressure.

In the following the invention will be described in further detail by means of an exemplary embodiment, and reference is made to the accompanying drawing, in which the single figure shows a schematic side view of a plant for the manufacturing of pellets.

In the figure of the drawing the reference numeral 1 identifies a pelletizing machine with an outlet 2 which opens into a pellet chamber 3. The pellet chamber 3 has a first vacuum pump 4 arranged thereto, which is arranged to maintain

the air pressure inside the pellet chamber 3 at a first desired value, lower than the ambient pressure. At its lower end, the pellet chamber 3 is provided with an outlet 5, in which there is positioned a gate lock device 6 of a known type, so that the low pressure of the pellet chamber 3 may be maintained while the pellet is discharged. The gate lock device 6 may with advantage be of a rotational type, so that pellets may be fed continuously out of the pellet chamber 3.

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The outlet 5 is connected to an inlet 7 in the upper part of an oil tank 8 which is partly filled with oil, which is not shown. The oil tank 8 has a second vacuum pump 9 arranged thereto, which is arranged to maintain the air pressure inside the oil tank 8 at a second desired value, which is lower than the ambient pressure and normally also lower than said first desired value of the pellet camber 3. Further, the oil tank 8 is provided, in a known manner, with a heating element with thermostatic control, possibly an agitator, which is not shown, in order to serve for the deep-frying of pellets.